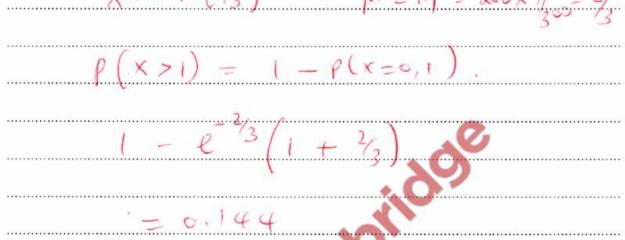
<u>The Poisson distribution – 2020 A2 Math</u>

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It is known that, on average, 1 in 300 flowers of a certain kind are white. A random sample of 200 flowers of this kind is selected.

(a)	the sample is white.	ne probability	that more than	1 flower in
	0 12	MINP	= 200 x 1/	= 2/







The probability that a randomly chosen flower of another kind is white is 0.02. A random sample of 150 of these flowers is selected.

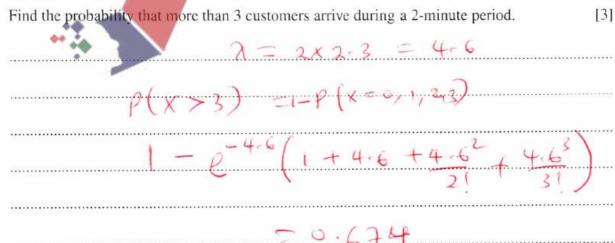
	an appropriate approximating distribution to find the probability that the total number of the flowers in the two samples is less than 4.
	$\mu = n\rho = 150 \times 0.02 = 3$
	$E(X+Y) = 3+\frac{2}{3} = \frac{1}{3}$
×	$Po(\frac{1}{3}) \qquad P(x \sim 4) \Rightarrow x = 0, 1, 2, 3$
	$e^{-\frac{1}{4}}\left\{1+\frac{11}{3}+\frac{\left(\frac{11}{3}\right)^{2}}{21}+\frac{\left(\frac{11}{3}\right)^{3}}{3}\right\}$
	=0.501
	Palpacalitio
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(a)	Find the standard deviation of the number of absences per week.
	V2.1 = 1.45
(b)	Find the probability that the number of absences in a 2-week period is at least 2.
	2-Week Renod 7=32
	P(X7 2); 1-(X =0,1)
	1-e (1+0-2)
	- 0602
	200
	No.
	••

Nov/2020/Paper_9709/62/No.1	
On average, 1 in 50 000 people have	a certain gene.
Use a suitable approximating distribusample of 150 000 have the gene.	ution to find the probability that more than 2 people in a random [3]
$\lambda = \epsilon$	np = 1 x 150,000 = 3
X Po	(3)
P (x	=1-f(x=0,1,2)
<u> </u>	$e^{-3}[1+3+3]$
	0.577
	Call

3.

	tomers arrive at a shop at a constant average rate of 2.3 per minute.
(a)	State another condition for the number of customers arriving per minute to have a Poiss distribution.
	Enotomers arrive independently or Singly or at random.
	Singly or at random.
It is	now given that the number of customers arriving per minute has the distribution Po(2.3).
(b)	Find the probability that exactly 3 customers arrive during a 1-minute period.
	A = 2.3
	$\rho(x=3)$ -2
	$= 2 \cdot 2 \cdot 3$
	31
	=0.203
	100



d)	Five 1-minute periods are chosen at random. Find the probability that no customers arrive during exactly 2 of these 5 periods. [3]
	p(no Custner anne) = e = 0.10026.
	P= 0.10026 9= 0.89974
	5c, (0.10026) x (0.89974)3
	= 6.6732
	Call
	Papacambile

5. June/2020/Paper_9709/61/No.5

Each week a sports team plays one home match and one away match. In their home matches they score goals at a constant average rate of 2.1 goals per match. In their away matches they score goals at a constant average rate of 0.8 goals per match. You may assume that goals are scored at random times and independently of one another.

(a) A week is chosen at random.

(i) Find the probability that the team scores a total of 4 goals in their two matches. [2]

 $\lambda = 2.1 + 0.8 = 2.9 \qquad \sim \rho_{\sigma}(2.9)$ $\rho(x=r) = e^{2r} \times \frac{2r}{r!}$

 $= e^{-2.9} \times 2.9^{4}$ $= -2.9 \times 2.9^{4}$ = 0.162

(ii) Find the probability that the team scores a total of 4 goals, with more goals scored in the home match than in the away match. [3]

for Po(2.1) > P(X=3,4) for Po(0.8) → P(X=4,0)

 $\frac{1}{3!}$ $\frac{2}{1!}$

0.0679 + 0.0446 = 0.1125

(b)	Use a suitable approximating distribution to find the probability that the team scores fewer than 25 goals in 10 randomly chosen weeks. [4]
	$\lambda = 10 \times 2.1 + 10 \times 0.8 = 21 + 8 = 29$
	•
	X~ N (29, 24)
	$p(x < 25) \simeq p(x < 24.5)$ approx
	P(Z<24.5-29) - P(Z<-0.8356
	29
	$P(Z < -a) = 1 + \phi(a)$
	P(Z<-0.836) = 1-\$ (0.836)
	0-7983
	= 0.2017
(c)	Justify the use of the approximating distribution used in part (b). [1]
	np>15 29715

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6.	lune	/2020	/Paper_	9709	/62	/No.3
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In the data-entry department of a certain firm, it is known that 0.12% of data items are entered incorrectly, and that these errors occur randomly and independently.

(a) A random sample of 3600 data items is chosen. The number of these data items that are incorrectly entered is denoted by X.

(i) State the distribution of X, including the values of any parameters. [1]

X~ B (3600, 0.0012)

(ii) State an appropriate approximating distribution for X, including the values of any parameters.

Justify your choice of approximating distribution.

[3]

 $X \sim Po(4.32)$ $7 = nP = 3600 \times 0.000$ n is very large (n = 3600)

normal not passible.

(iii) Use your approximating distribution to find P(X > 2). [2]

P(X = 2) = 1 = P(X = 0, 12)

 $1-e^{-4.32}(1+4.32+4.32^2)$

1 - 0.1949

= 0.8051

(b)	Another large random sample of n data items is chosen. The probability that the sample contains no data items that are entered incorrectly is more than 0.1 .
	Use an approximating distribution to find the largest possible value of n . [3]
	e-x >0.1
	-> lne > lno.1
	$\lambda < n 0$
	2 - 00 0 0 10
	$\lambda = n\rho \qquad \rho = 0.0012$ $\lambda = 0.0012n$
	1 = 0.00(XII
	0.0012n < 1110
	n < 1010
	00.0012
	n < 1918 8
	N < 1918

7. June/2020/Paper_9709/62/No.5	0.5	9709/62/	per	/2020/Pa	June	7.
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(a) The random variable X has the distribution $Po(\lambda)$.

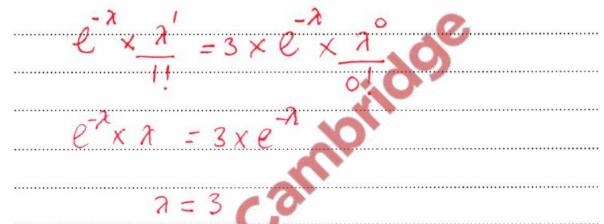
(i) State the values that X can take.

0,1,2,	3		
/ 1 /			
 ***************************************		••••••	••••••

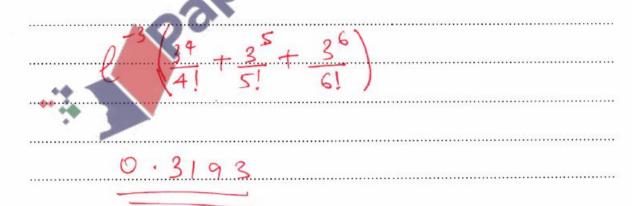
[1]

It is given that $P(X = 1) = 3 \times P(X = 0)$.

(ii) Find λ . [1]



(iii) Find $P(4 \le X \le 6)$. [2]



(b)	The random variable Y has the distribution $Po(\mu)$ where μ is large. Using a suitable approximating distribution, it is found that $P(Y < 46) = 0.0668$, correct to 4 decimal places.
	Find μ . [5]
	apposituation Ym N(M,M)
	P(Z < 45-5-M) = 6.0668
	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
	$\frac{4 - M}{5} = - \phi'(1 - 0.0668)$
	V ^M
	$\frac{45.5 - M}{-} = -\phi^{-1}(80.9332)$
	√M →
	45.5-M = 61.5
	7r~~
	4.55 M = -1-5 TM.
	$\mu - 1.5\sqrt{\mu} - 4 = 0$
	let x be TM.
	$\chi^2 - 1.5x - 45.5 = 0$
	$x = -6 + \sqrt{b^2 - 4ac}$
	$x = 1.5 \pm \sqrt{1.5^2 - 4(1)(-45.5)}$
	2
	L=1.5 ±13.57 X=7.537
	2.
	M=x= 56.8

The booklets produced by a certain publisher contain, on average, 1 incorrect letter per 30 000 letters, and these errors occur randomly. A randomly chosen booklet from this publisher contains 12 500 letters.

Use a suitable approximating distribution to find the probability that this booklet contains at least 2 errors. [3]



$$P(\mathbf{x}=\mathbf{r}) = e^{-\frac{x}{r!}}$$

$$1 - e^{-\frac{x}{2}}(1 + \frac{5}{n})$$



The number of accidents on a certain road has a Poisson distribution with mean 0.4 per 50-day period.

(a) Find the probability that there will be fewer than 3 accidents during a year (365 days). [3]

 $\lambda = 0.4 \times 365 = 2.92$

P(X < 3) = P(X=0,1,2) P(X=r) =

 $e^{-2.92\left(1+2.92+\frac{2.92^2}{21}\right)}$ $e^{-2}\frac{\lambda^2}{r}$

= 0.44135

= 0.441

(b) The probability that there will be no accidents during a period of n days is greater than 0.95.

Find the largest possible value of n. [4]

introduce ln

30.05/293 so be number of fays

0.051293 × 50 ÷ 0.4 (0.4 Rer 50 day Reno 2)

= 6.411 largest n is 6